of the substrate within the area enclosed by the chassis ground such that the isolated ground is electrically isolated from the chassis ground.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a perspective view of a voltage surge attractor, according to one embodiment of the present invention.

[0015] FIG. **2** is side view of the voltage surge attractor of FIG. **1**, according to one embodiment of the present invention.

[0016] FIG. **3** is a perspective view of an electronic device having a voltage surge attractor, according to one embodiment of the present invention.

[0017] FIG. **4** is a perspective view of the electronic device having a voltage surge of FIG. **3** which also shows electric field lines, equipotential lines and a simulated high voltage discharge from an ESD, according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0018] The present invention is directed to systems and apparatus for controlling electrostatic discharge on electronic circuit boards having a substrate for mounting electronic components, such as PCBs which have a substrate for mounting electronic components and conductive traces for electrically connecting the components.

[0019] Referring to FIGS. **1** and **2**, a voltage surge attractor **10** for controlling electrostatic discharge and protecting nearby, sensitive electronics is shown. The voltage surge attractor **10** is configured to attract the voltage and current from an ESD away from the protected circuit and to divert the voltage and current to a ground plane connected to the voltage surge attractor **10**. The voltage surge attractor **10** comprises a cylindrical main body **12**, a cone portion **14** and a cap **16**. The main body **12** is an elongated cylinder having a bottom end **18** configured to be mounted to a substrate for mounting electronics and a top end **20**. In alternative embodiments, the surge attractor **10** may include only the main body **12** and cap **16**. In yet other alternative embodiments, the main body **12** may not be cylindrical and simply be an elongated portion supporting a cap **16** at one end or an elongated portion having an enlarged distal end for functioning as a cap.

[0020] The cone portion **14** extends from the top end **20** of the main body **12**. The cone portion **14** has the shape of a conical frustum having a base **22** and a cone top **24**. The cone top **24** is formed with the tip of a cone shape removed. The cone portion **14** extends upward from the top end **20** of the main body **12** with the base **22** of the conical frustum on the top end **20** of the main body **12** and the cone portion **14** tapering upward from the base **22** to the cone top **24**.

[0021] The cap **16** of the voltage surge attractor **10** has a substantially spherical shape. In alternative embodiments, the cap **16** may have a substantially spheroidal or ellipsoidal shape. The cap **16** has a cap base **26** which interfaces (e.g., connects) with the cone top **24** such that the cap **16** extends upward from the cap base **26** and the cone top **24**. The spherical shape of the cap **16** assists in providing an omni-directional attraction of an ESD to the voltage surge attractor **10**.

[0022] The main body **12** also comprises a mounting seat **28** comprising a collar which extends outward around the circumference of the main body **12** near the bottom end **18** of the main body **12**. The mounting seat **28** facilitates mounting the voltage surge attractor **10** to a substrate by inserting the bottom end **18** of the main body **12** into a hole in a substrate such that the mounting seat **28** sits on the surface of the substrate. For example, the mounting seat **28** may contact a chassis ground trace disposed on the surface of the substrate around the hole in the substrate in which the bottom end **18** of the main body **12** is inserted.

[0023] The main body **12**, cone portion **14** and cap **16** may be formed as a single, integral structure, or they may be may formed as separate parts which are attached together to form the voltage surge attractor **10**. The main body **12**, cone portion **14** and cap **16** are preferably made of a metal which is electrically conductive. In addition, the parts of the voltage surge attractor **10**, including the main body **12**, cone portion **14** and cap **16**, may be plated with a metal or metal alloy, such as gold, gold alloys, silver, silver alloys, copper, copper alloys, etc.

[0024] The voltage surge attractor **10** is placed in the vicinity of sensitive electronics to protect the electronics from an ESD. In many cases, a plurality of voltage surge attractors **10** are placed in spaced apart location around the perimeter of the sensitive electronics. The voltage surge attractor **10** is positioned with the cap **16** extending upward or away from the platform or substrate upon which the sensitive electronics are mounted. Each of the voltage surge attractors **10** is electrically connected to a chassis ground. In the event of an ESD, the discharge is directed primarily through the voltage surge attractor(s) **10** as the voltage surge attractor(s) **10** are the nearest and lowest impedance path to the chassis ground, as described in further detail below.

[0025] Referring to FIG. **2**, the voltage surge attractor **10** and its components may be of any suitable size, including the following suggested dimensions:

$$(H1-H2)+H3+2R2=10 \text{ mm}$$

$$W2=2R2\geq 1.5 \text{ mm}.$$

$$W1\geq 1.15\times W2.$$

[0026] H2≥1.15×thickness of the substrate thickness (e.g., top substrate **32**, described below).

[0027] The radius R**2** may be equal to the radius R**1**. The distance from a top of the substrate (such as top substrate **32**, described below) to a top cover (not shown) for an electronic circuit board may be about 20 mm. In such case, the distance from the mounting seat **28** to the top of the cap **16** (i.e., the overall mounted height of the surge attractor **10**) may be about half the distance to the top cover (about 10 mm, as set forth the above: (H**1**−H**2**)+H**3**+2R**2**=10 mm). In other words, the distance from the top of the substrate to the top cover may be about twice the mounted height of the surge attractor **10**.

[0028] Turning now to FIGS. **3** and **4**, an electronic device **30** which utilizes the voltage surge attractor **10** is shown. The electronic device **30** includes a top substrate **32**, and one or more lower substrates **34** below the top substrate **32**. The lower substrates **34** include a bottom substrate **34***a* which is the bottom-most lower substrate. Each of the substrates **32** and **34** has a plurality of electronic components **36** and conductive traces **38**. For instance, the electronic component **36***a* may be an integrated circuit such as a microprocessor.